

RECREATIONAL FISHERIES – SOCIAL, ECONOMIC AND MANAGEMENT ASPECTS

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Abstract

The importance of commercial capture fishing is decreasing and recreation is becoming the more important beneficiary of fish stocks. In most developed countries recreational fishing is now the principal form of exploitation of most inland and many coastal waters. Approximately a tenth of the population across all countries engages regularly in recreational fishing, providing much social, economic and ecological benefit to society. Recreational fishing is a major economic driver; overall economic impact of angling in the United States of America being USD 125 billion, and in Europe the annual expenditure by anglers is an estimated EUR 25 billion (EUR 1,000 angler⁻¹). In addition there are benefits to the social fabric of both rural and urban areas. The regulation and management of recreational fisheries must address overall fishery performance, that is the total package of conservation or improvement of fish stocks and fish habitats, fishing satisfaction as measured by catches, and the fishers' environment such as scenic beauty, access to the water, and congestion management. An ecosystem approach to recreational fisheries management should be adopted wherever feasible and it is essential that

the sector recognizes its responsibilities. Issues for the recreational fisheries sector in the future include such challenges as multi-user demand on its resources, non-native species introductions, fish welfare, over-exploitation and changing attitudes of fishers and the public. Given that recreational fishing is a pleasure activity, management philosophy should rely less on fish ecology and increasingly on social science with stakeholders promoting recreational fishing whilst recognizing that this has to be alongside conservation and protection of the sector's resource.

Introduction

The fisheries sector comprises commercial, subsistence and recreational fisheries but commercial activity has predominated in marine and inland capture fisheries. In response to societal change, the importance of commercial capture fishing is decreasing and recreation is becoming the more important beneficiary of fish stocks. In most developed countries recreational fishing is now the principal form of exploitation of most inland and many coastal waters. Approximately a tenth of the population across all countries engages re-

gularly in recreational fishing, providing much social, economic and ecological benefit to society and harvesting millions of fish on a global scale. Unfortunately, in the context of international policy on the management and conservation of resources and ecosystems, recreational fisheries have been largely overlooked, probably in the belief that they are less valuable than commercial fisheries, but recent research has clearly challenged this perspective (Cooke and Cowx 2006) and the situation is being addressed.

Recreational fishing has been described as the ritual pursuit of pleasure associated with the experience and such experience is one of the most prized conditions of being human (Kellert 1984). There are two principal components to be considered; a fishing factor which includes the number and size of fish caught, and a recreational factor which includes non-catch components such as personal satisfaction. Aspects contributing to satisfaction are senses of freedom, excitement, relaxation, enjoyment of the natural setting and, less important than might be expected, catching a fish. Beyond this, in many places, recreational fishing is now big business and can be important both in contributing to rural economy and in providing social benefits in urban areas. It is also increasingly recognized that recreational fishing fulfils a valuable role in raising environmental awareness of wildlife and the environment.

History

Egyptians invented various methods for fishing and these are clearly illustrated in tomb scenes

and papyrus documents; the oldest known illustration of an angler using a rod or staff being dated about 2000 BC. It was in 1496, however, that the first real guidance on the use of a fishing rod was published in English. Usually attributed to Dame Juliana Berners from an abbey near St Alban's, the book is entitled *A Treatyse of Fysshynge wyth an Angle*. In the opening text the author asks "whiche ben the meanes and the causes that enduce a man in to a mery spyryte", goes on to name the "foure good disportes and honest gamys... of huntyng: hawkyng: fysshynge: and foulynge", and proclaims that "The beste to my symple dyscrecon whyche is fysshynge: callyd Anglyng wyth a rodde: and a lyne and an hoke.". This implication that angling can seemingly induce a person into a merry spirit certainly embraces the principle of recreation as it is understood today.

A later and equally definitive work followed in 1653 when English angler Izaak Walton published *The Compleat Angler, or the Contemplative Man's Recreation*; perhaps the single most influential book ever published about recreational fishing. Since this mid 17th century commendation of angling as a recreational pursuit, a whole variety of different angling practices have developed, both freshwater and marine.

Definitions

To require a correct and robust definition of 'Recreational Fisheries' might appear relatively unimportant but, in fact, there is a need for absolute clarity if best practice, policies and legislation

are to be developed and applied in an appropriate way. The FAO (1997) defined recreational fisheries as those in which *fishing is conducted by individuals primarily for sport but with a possible secondary objective of capturing fish for domestic consumption but not for onward sale*. This statement, based as it is on motivation, could be considered as not generic enough. A suitable redefinition could be: Recreational fisheries are those where *fishing is conducted during times subjectively defined by the individual as being leisure and for aquatic animals that do not constitute the individual's primary resource to meet nutritional (physiological) needs*. With this definition, if fish did constitute a primary resource to meet nutritional needs, the fishery would be commercial (if products are sold or traded) or purely subsistence but not recreational.

The recreational fisheries sector is best described as being the entire network of stakeholders involved in recreational fisheries from ministries, non-governmental organisations and managers through to associated business operators, the specialist media and, of course, the recreational fishers themselves. Also, some non-fisheries stakeholders could be considered part of the sector if their activities impinge on the exploitation of recreational fishing opportunities.

In theory, given that it is concept of catching fish as a leisure activity that makes recreational fishing what it is, any form of fishing gear can be used. In practice, however, certain fishing methods predominate, especially hook and line, gill nets, spears and various types of trap. Also, fishing with a specialized bow and arrow is increasing in popularity. Globally, however,

angling with a rod and line is by far the most common recreational fishing technique, which is why recreational fishing is often assumed to be synonymous with angling.

Status

Recreational fishing is one of the largest participatory pastimes. Across Europe, the number of anglers is approximately 25 million, representing 6.5 percent of the EU population, although such participation varies noticeably across countries, with Eastern Europe generally showing lower rates (e.g. Poland 1.6 percent, Slovakia 2.3 percent, Czech Republic 2.6 percent) and Nordic countries higher ones (e.g. Sweden 22.7 percent, Finland 26.7 percent, Norway 32.2 percent).

In the United States of America, almost 30 million adults went angling during 2006. Ignoring overlap, 25 million people fished in freshwater, 8.5 million fished in saltwater and 1.5 million in the Great Lakes. Activity was assessed at nearly half a billion fishing days. Similarly, fishing is an important leisure activity in Australia with 3.5 million (19.5 percent of the population) fishing at least once a year. Inland waters are much less frequented than in Europe or the USA with sea fishing at 45 percent of fishing effort (coastal 41 percent), estuarine at 35 percent and freshwater at 19 percent.

Note, however, that accurate participation figures are notoriously difficult to quantify. Assessment methods that use fishing licence sales tend to produce lower estimates than those obtained when specialist surveys are carried out.

This is because the number of people that can legitimately be counted as being anglers do not all fish during any one year, so the churn rate ought to be taken into account. For example, during a recent survey in England and Wales (Simpson and Mawle 2005), six percent of the population over 12 years of age said that they had been freshwater angling in the previous two year period but only 2.9 percent of the population held a fishing licence during the year of the survey. Notwithstanding such inaccuracies and errors, however, the popularity of recreational fishing cannot be disputed.

Target species

A fisher's preference for type of fishing and target species, angling or otherwise, is most likely influenced by upbringing, local practice, availability and fashion. The range of opportunity is immense; big game fishing in the Indian ocean, tournament fishing for bass in the United States, stealthy fly fishing for brown trout in an English stream, to name but a few.

European recreational fisheries are based mostly on coarse fish (cyprinids and other non-salmonids) whether or not the catch is generally retained (mainland Europe) or released (e.g. United Kingdom). Other species such as trout (*Salmo trutta*), salmon (*Salmo salar*), sea-trout (*Salmo trutta*) and pike (*Esox lucius*) are important to specialist fishers, especially in Nordic countries, but the generalization is fair as demonstrated by the following examples. In England and Wales, a typical angling catch from the middle reaches

of the River Severn comprises chub (*Leuciscus cephalus*), roach (*Rutilus rutilus*), dace (*Leuciscus leuciscus*), and gudgeon (*Gobio gobio*) as principal species (North and Hickley 1989). Records for France (CSP 2004) show bream (*Abramis brama*), zander (*Sander lucioperca*), barbel (*Barbus barbus*) and catfish (*Silurus glanis*) as important. In Poland (Wolos *et al.* 1998), carp (*Cyprinus carpio*), bream (*Abramis brama*) and roach (*Rutilus rutilus*) predominate.

In the United States (USF and WS 2006), black bass (*Micropterus salmoides*, *M. dolomieu*), catfish (*Ameiurus* spp., *Ictalurus* spp.) and trout (Salmonidae) sustain the bulk of recreational fishing in freshwater other than in the Great Lakes where walleye (*Sander vitreus*) take the lead. In the less popular sea fisheries, flatfish and red drum (*Sciaenops ocellatus*) are most frequently landed.

Principal finfish species harvested from salt-water by Australian recreational fishers are whiting (Sillaginidae), flathead (Platycephalidae), Australian herring (*Arripis georgianus*), bream (Sparidae), mullet (Mugilidae), and garfish (Hemiramphidae) (Henry and Lyle 2003). Also taken in large numbers are prawns (Penaeidae) and yabbies (*Callinassa australiensis*). In freshwater, carp (*Cyprinus carpio*) and golden perch (*Macquaria ambigua*) are the main catch from rivers, and perch (*Perca fluviatilis*) and trout (Salmonidae) from lakes.

Angler preferences can be seen to change with time. For example, in England and Wales the preferred target species amongst coarse (non-salmonid) anglers during 1969–1970 was roach

(*Rutilus rutilus* 39 percent) followed by pike (*Esox lucius*, 29 percent). In 1994, although one quarter of anglers did not mind which species they caught, of those with a preference, 36 percent expressed a preference for carp (*Cyprinus carpio*), 28 percent for roach (*Rutilus rutilus*) and 21 percent for bream (*Abramis brama*). Using reports in the angling press as a barometer of angler preference, not only is the popularity of carp fishing continuing to increase but the number of specialist anglers wanting to catch the exotic, novelty species is also increasing. Also, there is an increasing preference for stillwaters which has led to the creation and intensive stocking of purpose-built fisheries and an ongoing reduction of fishing on rivers.

Economic value

Sportfishing is truly a major economic driver and America's conservation powerhouse. This is the view held by the American Sportfishing Association. Moreover, there is evidence available to support such a view. In the United States of America, anglers generated USD 45 billion (USD 900 angler⁻¹) in retail sales. This level of spend stimulates the ripple effect of providing income which generates yet more spend. Economic multipliers can be remarkably effective; the overall economic impact of angling in the USA was USD 125 billion and this supported over 1 million jobs nationwide. Similarly, in Europe the annual expenditure by anglers is an estimated EUR 25 billion (EUR 1,000 angler⁻¹). The importance of this spend is put into perspective when compared with total EU fishery imports of

EUR 24 billion and exports of EUR 13 billion. In Australia, estimated expenditure on services and items attributed to recreational fishing was AUD 1.8 billion over a 12 month survey period, AUD 552 fisher⁻¹ yr⁻¹.

It is because environmental economics is such an important tool for the strategic management of the aquatic environment that in recent years attempts have been made to quantify the value of recreational fisheries, as in the following example from the United Kingdom. In England and Wales, recreational angling is an important business with the most recent study (Radford *et al.* 2007) having shown total angler effort on freshwater angling by licensed anglers to be 30.25 million angler days. The gross expenditure related to this level of activity is GBP 1.181 billion (USD 2.3 billion) with coarse (non-salmonid) angling responsible for GBP 971 million (USD 1.9 billion) of this. This equates to an average spend per angler of almost GBP 1,000 (USD 1,950) per year. In addition, these expenditures generated household income of GBP 980 million (USD 1,900 million) yr⁻¹ and supported 37,386 jobs across England and Wales. If angling were to cease, although expenditure would be diverted to other activities, it is estimated that over GBP 130 million (USD 250 million) in household income and 5,000 jobs would be lost.

Fisheries where there is a non-use public interest can also be described in terms of existence value, the value that is derived by an individual from knowing the resource exists regardless of whether or not it is exploited. Financial figures have been attributed to existence values but it

could be argued that it is their political rather than actual monetary value that is of greater importance.

Fishing as tourism is a particularly important component of the recreational fisheries economy in some countries. Of course, fishing days gained by one region or country are lost by the home location but there will be overall economic benefit to the sector from additional expenditure on travel and accommodation. In the United States, the top three destination states for fishing by non-residents were Minnesota, Florida and Wisconsin. The top three states for resident fishing days exported to other states were Illinois, Texas and Pennsylvania (Ditton *et al.* 2002). Some fishery development specifically targets tourist interest as the outcome e.g. the Funen sea trout (*Salmo trutta*) project in Denmark (Møller and Petersen 1998). It can be a specific species, rather than fishing in a particular region or country, that provides anglers with the motivation for fishing away from home. Freshwater angling tourists visit Ireland seeking high quality roach (*Rutilus rutilus*) and bream (*Abramis brama*), France for specimen carp (*Cyprinus carpio*) and Spain for the famous, giant wels catfish (*Silurus glanis*) of the River Ebro. The main attraction for sea angling tourists is often big game fish, especially billfish, and often in exotic locations such as Africa or the Caribbean. It is important, however, that infrastructure is such that an appropriate share of the tourist spend makes its way into the supporting country's economy. In Kenya, for example, where recreational sea fishing is almost entirely based on foreign tourism and daily fees run into many hundreds of

dollars, in some cases, only a small proportion of the income goes beyond the operating company.

It is clear, therefore, that angling in industrialised societies constitutes an important and highly valued leisure activity. Always associated with direct angling expenditure are indirect and induced financial flows in local, regional and national economies, including effects on employment and transfer of expenditure via tourism. Overall, recreational fishing provides a myriad of economic, social and ecological benefits to society, albeit the exact dimensions are often poorly known or very difficult to quantify.

Social welfare

Peirson *et al.* (2001) demonstrated benefits of recreational angling to the social fabric of both rural and urban areas. The mixed Atlantic salmon (*Salmo salar*) and sea trout (*Salmo trutta*) fishery of the River Teifi in rural Wales has not only injected money into the local economy but has also contributed to social benefits of generating employment. In Leeds, a large city (population circa 725,000) in the north of England, an important reason for people going fishing is that of being with friends. Many of the angling clubs in England and Wales are based at social clubs and places of work which highlights how fishing plays an important social, communication and relaxation role in the lives of the participants. In the inner city, recreational fishing can be particularly important in raising social and environmental awareness amongst young people, who are increasingly disconnected from the natural world.

That angling can become an alternative to crime and drugs is exemplified by the ‘Get hooked on fishing’ campaign in the United Kingdom (Brown 2007) whereby the police, Environment Agency and others support fisheries projects that provide angling opportunities for young people, thus providing positive distraction from involvement in youth crime.

Management

The basic fisheries resource needs to be managed so as to optimise the social and economic benefits from its sustainable exploitation. It is important to recognize that the resource comprises not just fish stocks but includes their habitat and all the economic and social features of the fisheries which the stocks actually or potentially support. Also, an understanding of the fishers’ environment is essential. There are two important components which recognize the human and non-human dimensions of recreational fisheries systems, namely improving the quality of life and enhancing wildlife. Thus, the regulation and management of recreational fisheries must address overall fishery performance, that is the total package of conservation or improvement of fish stocks and fish habitats, fishing satisfaction as measured by catches, and the fishers’ environment such as scenic beauty, access to the water, congestion management and so forth. In many instances, however, success is as much about management of perception as it is about reality.

One of the main challenges is to manage recreational fisheries with respect to changing

user habits and attitudes. Fishing pressure is often highest at key locations where anglers know they will get a good return for their effort. In particular, many lake fisheries are overstocked in conventional terms in order to meet popular demand for a guaranteed high catch rate. Modern management strategies not only have to balance the protection of stocks with fishery performance but also have to account for business needs. Such strategies must have a sound base and so fisheries science should have a role in supporting the interface between facts and perceptions when managing overall fishery performance.

An ecosystem approach to recreational fisheries management should be adopted wherever feasible. The ecosystem approach strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems, and their interactions, and applying an integrated approach to fisheries within ecologically meaningful boundaries. The ecological services thus derived from the aquatic ecosystems and fish stocks comprise services that are supporting (e.g. nutrient cycling), regulating (e.g. water quality), provisioning (e.g. fish yield, recreational fishing experience) and cultural (e.g. existence value, spiritual and educational dimension). In any event, management measures should attempt to ensure that recreational fishing effort is commensurate with the productive capacity of the fishery resource. In many recreational fisheries, it may be necessary to adopt a regional perspective such that management measures introduced for one fishery do not induce undesirable consequences

for another; for example, if fishers move to exploit a different fish stock in response to a new control measure.

A key tool in the management process is regulation. The law is capable of directing people away from certain ways of catching fish and towards others, the objective being to confine recreational fish capture to fair and sustainable methods. However, regulations should be used in as sensitive a manner as possible and be as sparing in their imposition as is compatible with preserving the ethic of stock conservation and the wise and acceptable use of the fishery. Transferable from the commercial sector are the traditional approaches to the protection of fish stocks and the maintenance of sustainable yield. Techniques include the imposition of closed sanctuary areas and closed seasons, limitations on the size or amount of catch, control over the amount of fishing, restrictions on types of gear used and the definition of permissible conduct. Note that input control measures (i.e. effort controls, closed areas, closed seasons) are more likely to be successful than output control measures (i.e. size-based harvest limits, bag limits, gear restrictions, mandatory catch-and-release) as the latter measures do not constrain total recreational fishing effort and mortality. Whatever regulatory mechanisms are employed, the implementation thereof is highly dependent upon education and liaison, whether this be the education of decision makers, user groups and general public or the improved understanding and communication between fisheries managers and the fishers.

For the effective management of recreational

fisheries in the long term, it is essential that the sector recognizes its responsibilities. Accordingly, the sector should:

- promote high quality recreational fishing experiences within the limits set by ecology, economics and society;
- adopt measures for the long term conservation and sustainable use of recreational fisheries resources;
- adopt the ecosystem approach as the guiding philosophy and exercise the precautionary principle;
- identify all relevant parties having a legitimate interest in the recreational fisheries resource and engage them in the management process;
- base recreational fisheries management action on pre-defined management objectives, formulated as a recreational fisheries management plan;
- consider all environmental, economic and social values and impacts in the appraisal of management measures.

A multitude of factors can contribute to good quality recreational fishing, e.g. scenic beauty, amenities, availability of fish species and the type of fish caught. Ultimately, the assessment of recreational fishing quality depends upon a subjective evaluation by the fisher as to the perceived fulfilment of the needs that the fishing experience was supposed to provide. So, irrespective of how good management strategies might appear to those responsible for implementation, account must be taken of such subjectivity so that the important element of fishery performance is not compromised. In this context, fishing trip

satisfaction has been defined as the fulfilment of various psychological outcomes (Holland and Ditton 1992). These include not only the catching of fish but also a sense of freedom, excitement, relaxation and enjoyment of nature. Unfortunately, with an increasing degree of industrialisation and urbanisation of societies, fishers are at risk of losing the ability to link aquatic ecosystem status to fish stock health and fishing quality.

Issues for the future

The main issues to be addressed now and in the future are not so much related to conventional fisheries problems but centre more around pressures induced by user groups and their activities and attitudes. Whilst there are universal, envi-

ronmental concerns such as water resource management, land use practices, diffuse point pollution and climate change, the recreational fisheries sector has to face such challenges as multi-user demand on its resources, non-native species introductions, fish welfare, over-exploitation and changing attitudes of fishers and the public.

Participation

Notwithstanding the demonstrable value of recreational fishing, some downward changes in participation rates could be problematic. Figure 1 shows three examples of fishing licence sales during a ten year period. Contemporary press reports quote the American Sportfishing Association as “being concerned about the numbers” and for France the headline is that the

Figure 1.
Numbers of recreational fishing licences sold in:
The USA
England and Wales
France
Data sources:
USA: US Fish & Wildlife Service
England and Wales: Environment Agency
France: Conseil Supérieur de la Pêche.



“number of fishers continues downward slide”. (The steady increase shown for England and Wales is the result of a specific action plan, outlined later in this section.)

To properly address participation issues it is necessary to understand types of anglers, reasons for fishing and, just as important, reasons for not wanting to fish. Clearly, being interested in the variety of aspects associated with a recreational activity is generally considered a pre-requisite for engaging in that activity. Some people do not fish because it is not something that they are interested in pursuing, while some may try fishing only to find out that they do not enjoy it. Others might have an interest but are constrained by factors that inhibit them from actively participating. Constraints on fishing and people’s behavioural response to different management actions were investigated by Aas (1995). In terms of the general, non-participatory public, there was a perception that fishing is boring. Interested non-participants cited constraints such as lack of time, child care responsibilities and old age. Not having someone to go fishing with is also a key factor. It is vital that stakeholders are able to recognize the nature of any constraints if marketing and management is to be cost-effective. As summarized by Fedler and Ditton (2000): *Intrapersonal constraints* are constraints that involve a person’s psychological state and affect preferences for recreational activities; *Interpersonal constraints* are constraints that are the result of personal interactions with others that can influence activity preferences as well as participation frequency; *Structural constraints* are items that generally come between the desire to

participate and the ability to do so. It is probably within the structural constraints category that most can be done to recruit participants. For example, whilst authorities can do little to address the lack of time constraint, they do have the facility to improve fishing access and opportunity.

Equally important as the assessment of actual participation is an assessment of churn rate. In Texas, of persons classed as recreational fishers, 17 percent were inactive, six percent were recent drop-outs, 27 percent had re-started fishing and only 50 percent were continually active anglers (Fedler and Ditton 2001). It was shown that in any particular year, nearly a quarter would quit fishing within one or two years. In terms of substitution activity, anglers were asked if there were other outdoor recreation activities that would provide them with the same satisfaction and enjoyment they received from fishing, 51 percent answering that there were (Ditton and Sutton 2004). The most frequently identified substitutes were hunting and golf for males, and camping and swimming for females. Knowing the relative proportion of residents and tourists who are likely to be interested or not interested in fishing within active, inactive, and non-fisher groups is essential if future trends in recreational fishing are to be predicted and managed.

To counter slippage in numbers of fishers, the benefits of recreational fishing needs to be better publicised to potential participants. A potential fisher is one who has not been fishing in the last few years but who is interested in doing so in the future and the category includes both lapsed participants and possible new recruits. Promotional

activity is extremely worthwhile, if the England and Wales experience is representative. Sales of angling licences have increased steadily in recent years (Figure 1) and this is considered to be the direct result of targeted marketing, developed specifically to increase participation (Environment Agency 2006). This promotional activity is expensive but an investment of two percent of licence income is preventing the decline in angling seen elsewhere and is delivering average sales income increases of six percent. In parallel, working in partnership with other stakeholders saw associated activities such as the creation of the Get Hooked on Fishing Charitable Trust, through which many thousands of young people have been coached successfully in angling and have then continued with the sport (Brown 2007). Also, National Fishing Week, whereby fishery owners organise about 500 events, gives people of all ages the opportunity to try angling for the first time. Note, however, that not all progress can be by enticement and some enforcement is a necessary part of the process, with unlicensed anglers being prosecuted and fined.

Conflicts between users

Much scope exists for conflict between user groups when human activity impacts upon the aquatic environment. Recreational users are likely to protest at the negative impacts of pollution, pesticides and eutrophication on water quality, and that of abstraction, hydro-power and impoundment on water resources. Less comprehensible is the often shown reluctance to sharing a recreational facility across

the user groups where a favourable interaction between fishers with others would be more constructive in maximising the benefits to society. Angling is known to conflict with groups such as bird watchers and boaters; the concept of behavioural interference. Apart from direct competition for use of the resource, there are concerns such as the damage done to wildlife by discarded fishing tackle. The conflict matrix can be complex but most areas of contention can be categorised as horizontal conflicts between potential users or vertical conflicts between management authority and user desires.

Consultation is always proposed as the panacea for conflict resolution. To a large extent this is true. Consultation with interest groups is essential, alongside a quantification of the scale of potential problems, and the establishment of decision making regimes. Increasingly, managing people, rather than managing the fish directly, appears to be a more constructive approach. Given that interactions and conflicts between stakeholders are the rule rather than the exception in many recreational fisheries, the sector and individual participants in recreational fisheries should ensure that decision making processes are transparent and differing views are handled in a democratic way. The participation of interested parties before policy actions are taken enhances the likelihood of a sustainable outcome in terms of recreational fisheries management in particular and aquatic ecosystem development in general. During any consultation process, however, it will be necessary to strive to avoid negative interactions both within the sector (e.g. between angler groups)

and across the sectors (e.g. between fishers, dog walkers, bird watchers, canoeists), and to reach compromise solutions based on mutual understanding and hard facts.

Stocking

The relative merit of creating and maintaining fisheries by stocking as against the protection of self-sustaining wild populations generates extensive debate. Meeting the needs of both the environment and fishers can place conflicting demands on fisheries management. Carp (*Cyprinus carpio*) fisheries in particular can be shaped by stocking as, for example, in Poland and the United Kingdom, and it is well known that carp can be damaging to the environment. Applied with caution, however, stocking can be a useful and sustainable rehabilitation strategy often supported by urban anglers, particularly in artificial water bodies where certain recruitment bottlenecks are very difficult to circumvent. Unfortunately, management of fisheries entirely by maintenance stocking can lead people to believe that good fishing results from simply putting fish in the water and reduces the effectiveness of aquatic education programmes and the efforts to make anglers part of the management process. Therefore, there is a need to publicise the risks associated with management by stocking and that abnormally high fish densities and opulent catch opportunities cannot be expected in every fishery.

The recreational fisheries sector must accept that many enhancement or maintenance practices, particularly stocking of farmed fish species,

can conflict with the conservation of aquatic biodiversity through such consequences as introgression of non-native genes, spread of disease, altered predator-prey dynamics and habitat changes. Ideally, stocking should not take place if natural recruitment is satisfactory and ought only to be an option if none other exists to maintain the fishery. Decisions should only be made after first assessing the potential ecological and economic advantages and disadvantages, following an appraisal protocol such as outlined by Cowx (1998).

Non-native species

There has long been a fascination with introducing non-native species. In the late 19th century, for example, non-native wels catfish (*Silurus glanis*) and zander (*Sander lucioperca*) were introduced into England. Unfortunately, the desire for the exotic has not waned and angling for novel species continues to be popular, leading to a proliferation of waters being stocked with alien species. Articles in the UK angling press relating to fishing for large, non-native fish such as wels catfish and sturgeon (*Acipenser* spp.) have fuelled a demand from the angling community for more opportunities to fish for exotic species. This has put financial and competitive pressures upon fishery owners, managers, fish farmers and fish dealers to provide fisheries with these highly sought after non-native specimens.

When a novel factor is added to an ecosystem in balance, the ecosystem will alter to accommodate it. It is the shift in balance that is unknown, in terms of severity and magnitude of impact on both threatened species and habitat.

The detrimental effects that could result from the stocking of non-native fish into recreational fisheries include direct predation, competition with indigenous fish, hybridisation with resident fish, the introduction of new diseases or parasites, and the alteration or degradation of the aquatic environment. Introductions of non-native fish should not in any circumstances be allowed to jeopardise the well being of natural ecosystems. This has happened world wide with introductions of carp (*Cyprinus carpio*), particularly in the United States, India, the Netherlands, and the Murray-Darling basin in Australia. Similarly, largemouth bass (*Micropterus salmoides*) has been introduced outside its native range specifically for recreational angling and has had a serious impact upon populations of endemic fish, such as in parts of the Iberian Peninsula (Godinho and Ferreira 1998). Of course, fisher demands for new experiences need be taken into account but non-native introductions should only be allowed where there are demonstrable social and economic components to any recreational benefit. It is essential to influence anglers, fishery owners and managers to stock non-native fish only where it is ecologically sound to do so and the precautionary approach (FAO 1996) should be adopted always when taking account of potential impacts.

Fishery collapse and sustainability

Recreational fisheries are typically, but incorrectly, viewed as being different from commercial ones in that they are often perceived to be self-sustaining and not controlled by the economic forces of the open market in a way that com-

mercial fisheries are. In many cases, however, the maintenance of the recreational sector is equally dependent upon the ability of aquatic ecosystems to provide fishery harvest. Commercial fisheries have been blamed repeatedly for the worldwide declines in fish populations and many commercial marine fisheries are in a state of collapse from over-exploitation. However, Cooke and Cowx (2004) contend that the recreational fishing sector also has the potential to negatively affect fish and fisheries and argue that the sector warrants consideration as a contributor to over-exploitation of fish in marine and inland waters. Unfortunately, the paucity of global statistics on recreational fishing participation, harvest, and catch-and-release has compromised the ability to understand fully the magnitude of any impact. Moreover, failure to recognize the potential contribution of recreational fishing to fishery decline will put important ecological and economic resources at risk, whereas identifying global conservation concern could facilitate development of strategies to increase the sustainability of recreational fishing. The sheer numbers of participants means recreational fishing cannot be seen as benign and needs to be better managed.

In Australia, recreational fishing is open access and, in many inshore regions, the catch does indeed exceed the commercial harvest. The environmental impacts from angling have been recognized as being ecologically significant and broad in scope; including the removal of biomass of many species, problems with introduced species, impacts on habitat through bait harvesting, damage to sea-birds and marine mammals, and

angler generated pollution. (McPhee *et al.* 2002) Such impacts of recreational fishing are cumulative but, where they are not actually ignored by those in authority, there is still a tendency to consider each impact in isolation. The concern is that unless the management approach changes to take account of the entire suite of ecological impacts, recreational fishing in Australia might not be ecologically sustainable in the long term. Similarly, in Canada, four high profile fisheries showed dramatic declines over the last several decades (Post *et al.* 2002). Contributory factors ranged from the predatory behaviour of anglers, which reduced angling quality, through to the ecological responses of disrupted food webs. Such evidence suggests that to prevent collapse of harvest-based recreational fisheries it is necessary for scientists and managers to ensure that models of sustainability adequately incorporate the angler-driven processes.

In addition to fish communities in general, individual species can become threatened by recreational fishing. Analysis of catch records in the United States of America shows that sport fishing is taking a heavier toll on some threatened marine species than is commercial fishing, landing 64 percent of the over-fished species along the Gulf of Mexico and 59 percent along the Pacific Coast. For individual stocks, the situation can be worse. In 2002, for example, sport fishing accounted for 93 percent of the catch of red drum (*Sciaenops ocellatus*) from North Carolina to Florida and 87 percent of the bocaccio (*Sebastes paucispinis*) catch in the Pacific. (Hecht and Vince 2004). In the coastal fisheries of Kenya, Mauritius, South

Africa and the Seychelles, similar challenges exist with several game fish listed as threatened species (WIOMSA 2006). Measures such as tag and release of sailfish (*Istiophorus platypterus*) are, however, helping to promote conservation and improve management strategies. Also, Marine Protected Areas have a part to play, enabling a combination of prohibition and zone separation for control of angling, shellfish collection and spearfishing.

A robust approach to legislation and change in angler behaviour is sometimes necessary if fishery collapse is to be prevented, as exemplified by the case of the Atlantic salmon (*Salmo salar*) in the United Kingdom. The numbers of Atlantic salmon returning to UK waters had declined significantly during the 1980s. In response, new restrictive national legislation was introduced in 1999 to meet international demands for action. Byelaws were introduced which required salmon caught early in the fishing season to be returned immediately to the water with the least possible injury. Although the situation for Atlantic salmon was showing some improvement as a consequence of such action, 2009 saw the introduction of additional byelaws to ban the sale of any salmon caught by rod and line. In similar fashion, it is expected that new Eel River Basin Management Plans (for *Anguilla anguilla*), mandated for Europe, will impinge on recreational fisheries as well as commercial ones.

Urban fisheries

With recreational fisheries management being as much about people as about fish stocks and

ecosystems, and with a background of increasing urbanisation, urban fisheries are necessarily becoming more important. Urban ecosystems generate important ecological services for society and, in general, enhance recreational and cultural values. As well as providing opportunities for activities such as bird-watching, boating and swimming, they can form a valuable fishery resource of benefit to many people and angling is often the single largest recreational activity in urban water bodies. Urban fishery restoration can make a major contribution to sustainable development by enhancing the social value of angling as a widely available and healthy form of recreation. Expert fisheries staff working in partnership with local councils and angling clubs can facilitate programmes to improve the availability and quality of fishing in urban areas. An additional benefit of increasing angling participation by urban populations is that this not only affects the metropolitan centres themselves but also, as the avidity of these new recruits increases, many might move into more rural fisheries outside towns and cities.

Urban fisheries are particularly important in terms of accessibility and their environmental and social benefits (Peirson *et al.* 2001). Thus, a key task within urban fishery development and rehabilitation is enabling good and environmentally sympathetic access to the fisheries. Accordingly, alongside the physical habitat improvement for fish, plans should include the creation of angling places and platforms, access paths, parking places, connection to public transportation and specialist facilities for the disabled. Properly managed in this way, urban fisheries provide a fishing oppor-

tunity for those unable to travel or with limited time availability, e.g. the young, the disabled and the elderly. It has been shown that significantly more young people, single people, and less educated people fish in urban than in rural waters (Arlinghaus and Mehner 2004a). Urban fisheries, however, not only serve the constituencies of the less mobile groups but also highly committed anglers and are especially important to people for whom angling is of great importance to their life style. Highly committed anglers are particularly important angling stakeholders because they are typically more successful and engaged as compared with less committed anglers and tend to benefit more from their angling (Arlinghaus and Mehner 2004b). Motivations of urban anglers, when compared with other angler groups, tend to be more catch orientated. In Germany, urban anglers placed greater importance on the achievement and quantity aspects of the angling experience (Arlinghaus and Mehner 2004a) and in North America (Manfredo *et al.* 1984) they had expectations of catching trophy fish and/or many fish with less emphasis on finding a challenging and unique fishery. Such attitudes have consequences for fishery management regimes because the non-catch motives – the so called play, rest and relaxation components – are probably easier to satisfy than catch-based ones.

Fish welfare

Fish welfare is an important aspect of contemporary recreational fisheries participation and management. The topic is being raised as a matter of

concern more frequently by a number of segments of society. Public influence is having various but generally increasing impacts in different countries. In Germany, for example, a good reason is required for fishing in the context of leisure as against fishing for food. National attitudes are always going to vary but attempts must be made to keep economic, environmental and sporting motives in balance.

Public acceptance of recreational fishing is important. In many instances it is the public sector, on behalf of the fishers, that is involved in setting up and maintaining the institutional infrastructure by which the fisheries are managed, whether it be local council provision of facilities or international agreements on migratory fish stocks. A survey on public attitudes to angling was conducted in England and Wales (Simpson and Mawle 2005). This clearly showed that most people viewed angling positively with 71 percent agreeing with the statement that “Angling is an acceptable pastime” and only eight percent disagreeing. There was less certainty, however, about whether “Angling is a cruel pastime”; 24 percent agreed, whilst 47 percent disagreed and 26 percent neither agreed nor disagreed. Nonetheless, when the United Kingdom published its new Animal Welfare Bill in 2005 it was specifically stated that nothing in it applies in relation to anything which occurs in the normal course of fishing.

Practical things can be done to show recreational fishing in a good light. Good welfare means that an individual fish is in good health, with its biological system functioning properly and

not being forced to respond beyond its capacity (Arlinghaus *et al.* 2007). Therefore, fishers should make efforts to minimize or avoid fish welfare impairments by accepting that the nature of their activity may cause harm to individual fish and adopt behaviours that minimize or avoid detrimental impacts. Careful handling of fish, state of the art designs for keep nets and the use of barbless hooks are examples of how anglers are able to contribute directly to fish welfare. Improved fish handling will help to close the perceived cultural divide between the fishing and animal welfare factions. Unfortunately, in some instances there is evidence of an increasing pattern of greed, with more anglers competing for trophies or money and some fishery owners promoting angling as the basis for business with little regard for the welfare of either the population or individual fish. This does little good to the reputation of recreational fishing as a legitimate activity and should be countered by a combination of enforcement and education.

Catch and release

Catch-and-release angling has a long history and has received increasing attention recently. It refers to the process of capturing a fish, usually by angling, and releasing it alive. Catch-and-release involves a continuum from mandatory release of protected sizes and species to voluntary catch-and-release of unprotected fish (Arlinghaus *et al.* 2007). World wide, many millions fish are released after capture by recreational anglers each year, the release rate being about 60 percent (Cooke and Cowx 2004). In the United States

of America in 2000, an estimated 11 million anglers participated in 78 million marine fishing trips and caught 445 million fish, of which 57 percent were released. However, diversity of culture, institutional environments and target species means difficulty in obtaining reliable estimates that apply in general. Angling for coarse fish (non-salmonid) species in the United Kingdom exemplifies an extreme situation where almost all fish are released. The same is true for some specialist fisheries around the world, such as big game angling in the USA, e.g. for Atlantic white marlin (*Tetrapturus albidus*) and bonefish (*Albula vulpes*), and for carp (*Cyprinus carpio*) in much of Europe. Release rates are much lower in many recreational fisheries in parts of Eastern and Northern Europe where much of the catch is still taken for human consumption.

Release of fish in compliance with regulations is unlikely to be contentious because such release is seen to enable the implementation of necessary control measures. That angling can impact fish stocks is receiving more attention because in many temperate freshwater systems, and some coastal ones, recreational fishing has largely replaced commercial fishing as the principal exploiter of fish stocks. Using estimates from Canadian recreational fisheries, Cooke and Cowx (2004) suggested that on a global scale, angling catch could be as high as 47.1 billion fish annually, of which about 17 billion are retained. So, from a fisheries management and conservation point of view, common sense would suggest that further application of catch and release encourages the biological, economic, and social sustainability

of recreational fishing. In contrast to mandatory release of specific categories of fish, voluntary catch and release can induce controversy. This form of catch and release could be seen as the perfect expression of the fact that recreational fishing is not about the necessity to obtain food. In such situations, there is no desire to kill and eat the fish and the release itself becomes very important. It is against such activity that ethical arguments are mounted because of the disconnect with need. For example, for some stakeholders, releasing fish is a reprehensible practice because the act of catching can then be perceived as playing with fish for no good reason. Such an attitude has created social and legal conflicts in Germany with some anglers receiving monetary fines for releasing trophy fish and it being deemed cruelty to animals (Arlinghaus *et al.* 2007). Catch and release is, therefore, somewhat complex to manage because the history, laws, culture and economic environment differ from one country to another. Undoubtedly, however, the relevance of its application will increase in the future.

Education

Education and liaison between the authorities, fishers, fishery owners and the general public is crucial if interested parties are to closely identify with the management of the recreational fishery resource. Education should aim at a meeting of minds between scientists, managers and participants. Recreational fishing organisations can be limited in their vision, often focussed on a single species group, whereas they would have much to share and much to gain by exchange of informa-

tion. The tendency to fail to recognize the importance of healthy ecosystems and to understand the complexity of fisheries management could be addressed by improved communication. The sector must improve its education and awareness role if the benefits of recreational fishing are to be protected in the long term. Techniques range from the straightforward issue of informative literature through stakeholder meetings to the formal training and examination currently found in Germany. Whatever, there is a need to promote responsible recreational fisheries through education of recreational fishers, interested people, managers, politicians and other stakeholders. Publicity should be given to conservation and management measures to ensure that regulations governing their implementation are effectively disseminated, with the bases and purposes of such measures being explained. Fishing communities and individuals should be engaged in the formulation of policy and management plans, establishing co-management where appropriate. In essence, awareness and education programmes should be aimed at improving knowledge, attitudes and behaviour of all those engaged in the recreational fisheries sector. Public outreach is important. Communication of the economic and social value of recreational fisheries practices will help strengthen the sector and enable further development for the benefits of fish, the environment and those that enjoy recreational fishing.

Codes of practice

Voluntary codes of practice already exist in some countries and organisations therein. For example,

in the United Kingdom, the National Angling Alliance has produced a Code of Conduct for Coarse Anglers covering such aspects as care of the environment, general behaviour, tackle and fish handling. Although many other countries have a similar inclusion of behavioural, conservation and fish welfare recommendations in leaflets and guidebooks, produced either by the authorities or angling associations, there has been little in the way of high profile, nationally agreed, promotional documentation. In Australia, however, a national code of practice has been published as a joint initiative between the authorities and the fourteen national and state fishing associations (Recfish Australia 1996). Also, the Nordic Angler Association, which covers Denmark, Sweden, Finland, Norway and Iceland, has established a code for recreational angling. Nonetheless, there is still a perceived need for more international agreement on good practice. Accordingly, facilitated by the European Inland Fisheries Advisory Commission (EIFAC), a new international Code of Practice for Recreational Fisheries has been developed to assist this process (FAO 2008).

In its Code of Conduct for Responsible Fisheries, the FAO (1995) states that users of living and aquatic resources should conserve aquatic ecosystems and that the right to fish carries with it the obligation to do so in a responsible manner so as to ensure effective conservation and management of the living aquatic resources. Accordingly, the objective of the EIFAC Code of Practice for Recreational Fisheries is to establish best practice principles among nations for responsible management and fishing practices, taking into ac-

count all relevant biological, technological, economic, social, cultural and environmental aspects. The Code has to fit alongside national legislation and regional best practice guidelines and is designed to prescribe the minimum standards for environmentally friendly, ethically appropriate and socially acceptable recreational fishing. It works from the general assumption that recreational fisheries provide a vital source of recreation, employment, food and social and economic well-being for people throughout the world, both for present and future generations. It acknowledges that recreational fishing and its associated social, cultural, psychological and physiological benefits provide quality of life for its participants; an aspect less obvious to some in society. These tangible and less tangible benefits are different to those of food and income that have been traditionally associated with fishing. To continue being viable, recreational fishing must minimize its ecological impacts and harmonize stakeholder interactions whilst delivering maximum benefits to the sector. The EIFAC Code of Practice for Recreational Fisheries should facilitate this but it has no formal legal status; it is a voluntary instrument. The challenge is finding the corporate will for its implementation.

Concluding remarks

At its Session in 1996, EIFAC had recommended that the true value of recreational fisheries should be included in decision making processes by taking into account the full economic and social value of the aquatic ecosystem (Hickley

and Tompkins 1998). It can be seen that, even many years on, this recommendation remains pertinent. One of the major points of relevance of economic and social value is its contribution to arguments necessary for justifying amelioration of anthropogenic impacts, such as obstructions, pollution and climate change; for example, influencing programmes of measures under the European Water Framework Directive. In such debates, consideration of full economic impact is key, it referring to moving money around and benefiting from it whereas this is not necessarily the case for pure economic value.

It must be remembered that recreational fishing is a pleasure sport and this is the principal reason why future management philosophy should come to rely less on fish ecology and increasingly on social science. Stakeholders will need to embrace the challenge of promoting recreational fishing whilst recognizing that this has to be alongside conservation and protection of the sector's resource.

More people are becoming interested in recreational fisheries management policy formulation, and globalization adds to the complexity of management. Unfortunately, many recreational fisheries organisations, and even government institutions, are focussed on single species group issues. Wider education, vertically and horizontally, amongst the scientists, regulators, fishery owners, managers and the fishing community is essential. Better communication will help the way forward but it has to be taken seriously if it is to be effective. For any new policies and strategies, much can be gained by the development of

formal communication plans which are then implemented through robust project management processes. Such an approach is recommended.

The future can be bright. Many stakeholders are already willing to promote and safeguard the enduring social, economic and conservation values of recreational fishing. So, with a little improvement world-wide, it yet might be possible to align the sector to a vision of all waters being capable of sustaining thriving fish populations and everyone having an opportunity to experience a diverse range of good quality fishing.

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